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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/420,157	10/18/1999	ROBERT WILLIAM FILAS	22-176-48-44	2407

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EXAMINER
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ROY, SIKHA

ART UNIT	PAPER NUMBER
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2879

DATE MAILED: 11/06/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

**Application No.**

09/420,157

**Applicant(s)**FILAS ET AL. **Examiner**

Sikha Roy

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 21 August 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☐ Claim(s) \_\_\_\_\_ is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5 and 9-18 is/are rejected.
- 7) ☒ Claim(s) 6-8 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

### Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_ 6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on August 21, 2002 has been entered.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1,2,4,5,9-12, 15,16 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,973,444 to Xu et al. in view of U. S. patent 6,232,706 to Dai et al.

Referring to claim 1 Xu et al. disclose (column 3 lines 7-14, column 5 lines 9-23, column 6 lines 58-62 Fig.1) a cold cathode device comprising a substrate 12 supporting a composite material (growth surface) 14 containing conducting metal catalyst or metal containing compound from the surface of which nanotubes 20 protrude. The catalysts are selected from any one of the group comprising Fe, Ni, Co, Cr which are magnetic material and hence the nanowires are at least partially coated with magnetic material.

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The substrate includes plurality of current paths each coupled electrically to a respective one or more of the nanowires (electron emitters). Xu et al. further disclose (column 9 lines 60,61) the nanotubes protruding from the surface of the composite material has height greater than about twice the diameter (aspect ratio : height over width > 2).

Claim 1 differs from Xu et al. in that Xu et al. do not exemplify the average length of the nanowires of about 0.1 to about 10,000 micrometers.

Dai et al. in analogous art of carbon nanotubes disclose (column 2 lines 32-37) nanotubes upto 300micrometers tall. It is further noted (column 1 lines 19-26) that nanotubes being electrically conductive along their length, having very small diameters and suitable length can be used as field emission devices.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to specify the length of the nanotubes of Xu et al. about 300 micrometers as taught by Dai et al. for using them as electron emitters in a field emission device.

Regarding claim 2 Xu et al. disclose (column 3 lines 14,15) field emission devices comprising electron emitter structure having composite material from the surface of which nanotubes protrude.

Referring to claim 4 and 5, Xu et al. only teach that nanowires protruding from the composite material patterned with metal film are partially coated with the material. Xu et al. do not exemplify the volume percentage of magnetic material comprising the coating of the nanowires. It would have been obvious to one having ordinary skill in the art at the time the invention was made to specify the magnetic material comprising less than 0.95 or 0.75 volume % of the coated nanowires, since it has been held that

discovering an optimum value of a result effective variable involves only routine skill in the art.

Regarding claim 9 Xu et al. disclose (column 9 lines 43-47) that depending on how the nanotubes are grown some are straight and some are with irregular twisting structure resulting in variation in average protrusion height. Xu et al. do not exemplify the percentage variation of protrusion height. It would have been obvious to one having ordinary skill in the art at the time the invention was made to specify the percentage variation less than 40%, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art.

Regarding claim 10 Xu et al. disclose (column 6 line 1) the composite material comprising conductive metal film or metal containing compounds.

Regarding claim 11 Xu et al. disclose (Fig. 1) that the composite material 14 is disposed on the substrate 12 as an arrayed emitter structure.

Referring to claim 12 Xu et al. disclose (column 5 lines 25-31) the composite material is a part of the emitter structure and the device further comprises an apertured grid 15 located over a portion of the composite material, the grid comprising a grid layer and an insulating layer (dielectric film) 16.

Regarding claim 15 Xu et al. disclose (column 3 lines 39, 40) the nanowires made of carbon.

Referring to claim 16 Xu et al. disclose (column 9 lines 30-39) that the nanowires are carbon nanotubes and the nanotubes contain magnetic material (Fe,Ni,Co,Cr) inside.

Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 5,973,444 to Xu et al. and U. S. Patent 6,232,706 to Dai et al. and further in view of U. S. Patent 5,726,524 to Debe.

Regarding claim 3 Xu et al. and Dai et al. do not disclose the nanotubes with broken ends.

Debe in relevant art of nanostructured emitters disclose (column 12 lines 27-46) depending on the energy and temperature during growing process of the nanotubes (whiskers) some have broken ends (deformed). It is further disclosed that this provides an advantage for field emission from the microstructures having multiple potential emission sites in the form of nanoscopically rough features.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include protruding nanotubes with broken ends as suggested by Debe in the nanotube emitter structure of Xu and Dai et al. providing advantage for field emission from the microstructures having multiple potential emission sites in the form of nanoscopically rough features.

Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 5,973,444 to Xu et al. and U. S. Patent 6,232,706 to Dai et al. and further in view of U. S. Patent 5,191,217 to Kane et al.

Regarding claim 13 Xu and Dai et al. do not exemplify second grid conducting layer separated by a second insulating layer from the first grid conducting layer.

Kane et al. in relevant art of field emission device disclose (Fig. 1, column 2 lines 41-60) another second grid layer (deflection electrode) 105 separated from the first conducting grid 103 by insulating layer 104. Kane et al. disclose this second conducting grid or deflection electrode modifying the electron trajectories providing electron beam with pre-determined crossection.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include a second conducting grid separated by an insulating layer as taught by Kane et al. in the conducting grid of the field emission device of Xu et al. for modifying the electron trajectories providing electron beam with pre-determined crossection.

Regarding claim 14 Xu and Dai et al. in view of Kane et al. disclose the claimed invention except for third and fourth conducting grid layers, the third grid layer separated from the second grid by a third insulating layer and the fourth grid layer separated from the third grid by a fourth insulating layer. It has been held that mere duplication of the essential working parts of a device involves only routine skill in the art. It would have been obvious to one having ordinary skill in the art at the time the invention was made to include third and fourth conducting grids separated by insulating layers from the grids below for further modifying the electron trajectories , since mere duplication of essential parts of the invention is considered within the skill of the art. *In re Harza*, 274 F. 2d 669,124 USPQ 378 (CCPA 1960).

Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 5,973,444 to Xu et al. and U. S. Patent 6,232,706 to Dai et al. and further in view of U. S. Patent No. 5,456,986 to Majetich et al.

Majetich et al. in relevant art of magnetic metal nanoparticles disclose (column 5 lines 9-13) the nanoparticles comprising of paramagnetic or ferromagnetic compound, the ferromagnetic compound selected from the group consisting of iron, cobalt, nickel. Majetich et al further teach (column 6 lines 16-18) that the nanoparticles packed with paramagnetic or ferromagnetic material can be segregated by magnetic moment per volume by varying magnetic field.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to specify the coating of the composite structure comprising of Fe, Ni, Co as ferromagnetic group as taught by Majetich et al. so that the nanowires grown on the composite material can be segregated by applying varying magnetic field.

Regarding claim 18, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the structure from the group comprising near-super-paramagnetic and super-paramagnetic, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice.



***Allowable Subject Matter***

Claims 6-8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claims 6 and 7 the prior art of record neither shows nor suggests a device with aligned nanowires with the limitations as claimed in claims 6 and 7 and particularly the limitation of the average protrusion height being 20nm and 100nm respectively.

Regarding claim 8 the prior art of record neither shows nor suggests a device with aligned nanowires with the limitations as claimed in claim 8 and particularly the limitation of the composite material comprising at least 1vol% nanowires to a depth of at least 2 micrometers from the surface from which the nanowires protrude.

***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U. S. Patent 6,062,931 to Chuang et al. and U. S. Patent 6,057,637 to Zettl et al. disclose field emission electron sources with carbon nanotubes.

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**Contact Information**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sikha Roy whose telephone number is (703) 308-2826. The examiner can normally be reached on Monday-Friday 8:00 a.m. – 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimeshkumar D. Patel can be reached on (703) 305-4794. The fax phone number for the organization is (703) 308-7382.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

S.R.

Sikha Roy  
Patent Examiner  
Art Unit 2879



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